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Research review

Psychological benefits of weight loss following behavioural and/or dietary weight loss interventions. A systematic research review ☆

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ABSTRACT

It is generally accepted that weight loss has significant physiological benefits, such as reduced risk of diabetes, lowered blood pressure and blood lipid levels. However, few behavioural and dietary interventions have investigated psychological benefit as the primary outcome. Hence, systematic review methodology was adopted to evaluate the psychological outcomes of weight loss following participation in a behavioural and/or dietary weight loss intervention in overweight/obese populations. 36 Studies were selected for inclusion and were reviewed. Changes in self-esteem, depressive symptoms, body image and health related quality of life (HRQoL) were evaluated and discussed. Where possible, effect sizes to indicate the magnitude of change pre- to post- intervention were calculated using Hedges' g standardised mean difference. The results demonstrated consistent improvements in psychological outcomes concurrent with and sometimes without weight loss. Improvements in body image and HRQoL (especially vitality) were closely related to changes in weight. Calculated effect sizes varied considerably and reflected the heterogeneous nature of the studies included in the review. Although the quality of the studies reviewed was generally acceptable, only 9 out of 36 studies included a suitable control/comparison group and the content, duration of intervention and measures used to assess psychological outcomes varied considerably. Further research is required to improve the quality of studies assessing the benefits of weight loss to fully elucidate the relationship between weight loss and psychological outcomes.

Contents

☆ *Conflict of interest:* All authors declare that there are no conflicts of interest.

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Introduction

It is well documented that weight loss in overweight or obese individuals has significant physiological benefits, for example, reduced risk of diabetes, lowered blood pressure and blood lipid levels (Franz et al., 2007). Many weight loss interventions, therefore, focus on strategies to reduce weight and improve physiological health. The success of these interventions is often based solely on amount of weight lost. However, both obesity and weight loss have psychological consequences and conversely psychological problems may lead to weight gain. Obesity is commonly associated with a negative stigma and obese individuals can often be subjected to negative stereotyping. That is, obese individuals are often viewed as lazy, greedy and weak willed (Puhl & Brownell, 2001). The overt stigma of obesity, has been associated with low self- and body esteem, depressive symptoms and poor quality of life (Friedman et al., 2005). Weight loss may therefore serve to improve these psychological outcomes and, in turn, these improvements may increase the chances of maintaining successful weight loss (Teixeira et al., 2004). Knowledge of the psychological correlates of obesity is, therefore, important when trying to understand how people may become obese, lose weight and maintain weight loss.

The majority of previous research, which explores the efficacy of weight loss interventions, lacks assessment of psychological changes associated with weight loss. Of those studies which assess psychological correlates, psychological improvements were not typically the primary outcome (Boan, Kolotkin, Westman, McMahon, & Grant, 2004; Madan, Beech, & Tichansky, 2008). The samples in these studies typically comprise morbidly obese individuals with concurrent physiological and psychological co-morbidities. However, despite this, improvements in some psychological outcomes have been documented. In a meta-analysis of the psychological outcomes of surgical, pharmacological and behavioural weight loss interventions for weight loss, Blaine, Rodman, and Newman (2007) noted consistent significant improvements in depressive symptoms following surgical and pharmacological interventions. Consistent improvements in self-esteem were also observed after all forms of intervention but more so following behavioural interventions than surgical or pharmacological approaches. Further, improvements in self-esteem were moderated by the absolute amount of weight loss, whereby greater weight loss was associated with greater improvements in self-esteem. Improvements in depressive symptoms, however, were not associated with degree of weight change unlike self-esteem (Blaine et al., 2007). These discrepant findings highlight differential effects dependent on the nature of the intervention used and the outcome under investigation. Furthermore, improvements in psychological outcomes may not always be dependent on actual weight loss.

Behavioural interventions are a common approach to weight loss and can vary greatly in the form in which they are delivered. Such interventions typically include the following elements: (i) an attempt to understand and control eating behaviour (for example, emotional triggers of eating), (ii) attitudes to eating, (iii) good nutrition, (iv) seeking and utilizing social support and (v) exercise (Brownell & Kramer, 1989). These programs can also include dietary advice (often with caloric restriction) and an exercise program. The program can be prescriptive (i.e. a hypocaloric, exercise program tailored to a particular individual with advice and social support) or consist of general lifestyle advice (for example, national government health guidelines for daily dietary intake and exercise). Some behavioural interventions focus on the cognitive elements of eating behaviour and explore dysfunctional thoughts about weight or body shape. Triggers of eating behaviour are identified and an attempt is made to alter these thought processes to promote healthy eating through self-monitoring and cognitive restructuring.

Participation in behavioural and/or dietary weight loss interventions (with or without exercise) has the potential to reduce weight and concurrently improve psychological outcomes. Identifying and understanding the psychological changes that co-occur with weight loss may contribute to a greater understanding of how weight loss may be promoted and, more importantly, maintained. Therefore, the aim of the present review was to provide a systematic review and quality assessment of studies that employed a behavioural and/or dietary weight loss intervention (with or without exercise) and assessed the psychological consequences of weight loss in a sample of overweight and obese individuals. The psychological correlates most frequently measured were identified and are discussed in terms of the consistency of psychological improvements and the association of these changes with actual weight loss.

Table 1
List of search terms ($ denotes word truncation; ∗permits variation in spelling).

	Search strings
1	Weight loss AND adults AND psych$ AND behavio∗ral intervention
2	Weight loss AND adults AND behavio∗ral intervention
3	Weight loss AND adults AND psych$
4	Weight loss AND adults AND self esteem
5	Weight loss AND adults AND depression
6	Weight loss AND adults AND mood
7	Weight loss AND adults AND body image
8	Weight loss AND adults AND health related quality of life
9	Weight loss AND adults AND vitality

Literature search

Search strategy and search terms

Searches of electronic databases were carried out on 28 August 2012. Databases searched included MedLine (1946-August 2012), PsycInfo (1806-August 2012), PsycArticles (1894-August 2012) and Web of Science (1965-August 2012). Table 1 provides the search terms and strings within each database.

Inclusion and exclusion criteria

Studies were included or excluded in this review using the following criteria:

Participants

The target sample included overweight and obese (up to a body mass index [BMI] of 45 kg/m^2) males and females who were otherwise healthy with no concurrent disease or clinical psychopathology (for example, diabetes, cardiovascular disease

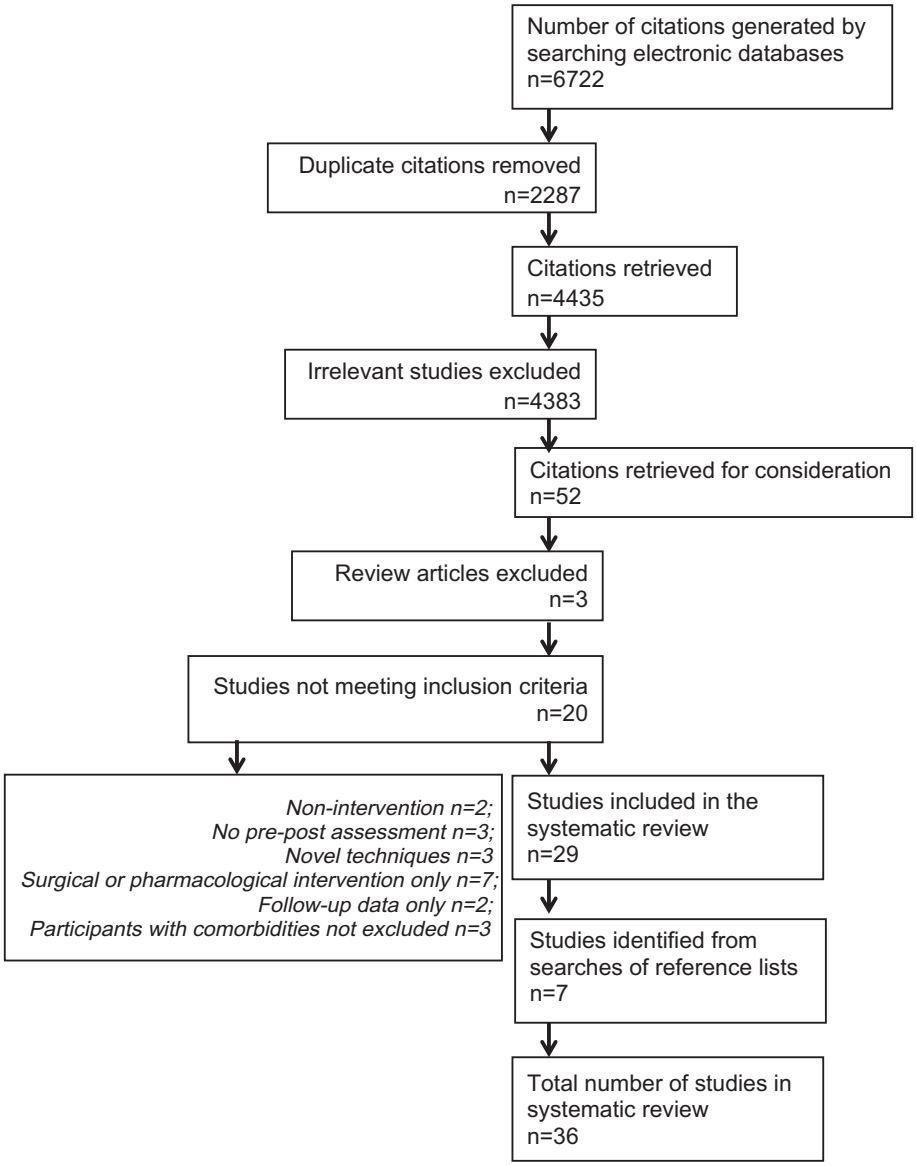

Fig. 1. Study selection process.

or binge eating disorder). The review focused on an adult sample with an age range of 18–65 years.

Manipulations

Any type of behavioural and/or dietary intervention with or without exercise was included. Two studies which compared a behavioural intervention with a 'non-diet' approach were included. Studies which involved a surgical or pharmacological intervention were excluded unless the study included a comparative behavioural intervention arm. Studies utilising novel/remote techniques such as telephone, internet or postal interventions were not included. Review papers were also excluded.

Outcome measures

Studies which involved a pre to post assessment of psychological outcomes following a behavioural and/or dietary intervention with or without exercise and with or without a control/comparison group were included. Cross-sectional studies exploring differences between obesity groups in the absence of an intervention were excluded.

Study selection process

Figure 1 details the stages of study selection and the number of studies excluded at each stage. The search strategy yielded a total of 4435 citations after removal of duplicates. Many studies were excluded due to a lack of psychological assessment pre- and post weight loss intervention. Following exclusion of studies that did not meet the inclusion criteria and review articles, 29 studies remained. One study (Brodie & Slade, 1990) did not report actual BMI scores but was included as the sample was described as overweight thus meeting this inclusion criterion. Additional search strategies included hand searches of reference lists of review articles identified. Seven further studies were yielded using this strategy and hence 36 studies were included in this review.

Table 2
Psychological outcomes following behavioural weight loss intervention (n = 25).

Reference	QA	Sample	BMI (kg/m^2)	N	Intervention	Duration	Measures	Outcome
Ames et al. (2005)	12	Overweight/obese females aged 18–30 (mean = 21 ± 2.2 years)	31.1 ± 2.9	28	Standard behavioural intervention (SB) (Phase 1) with follow up SB versus reformulated cognitive behavioural treatment (RCB) (Phase 2) and 6mth follow up (Phase 3)	Phase 1: 10 wks Phase 2: 10 wks Phase 3: 6 mths	SE: RSE D: BDI-II BI: MBSRQ (AS and BAS)	Increased self-esteem in RCB, increased body satisfaction in both SB and RCB but no change in D at the end of Phase 2. Improved AS in RCB, SE in SB and D in both SB and RCB after Phase 3 Relationship with weight loss not assessed but greater weight loss in SB
Annesi and Gorjala (2010)	13	Overweight/obese males and females aged 21+ (mean = 43.5±10 years)	42 ± 6	106	Cognitive behavioural intervention with supported exercise and nutrition	6 mths	D: TMD (POMS)	Improved TMD Relationship with weight loss not assessed
Annesi and Whitaker (2010)	16	Obese/morbidly obese females aged 21+ (mean = 44.2 ± 9.4 years)	Obese: 34.77 ± 2.85; Morbidly obese: 43.61 ± 2.77	173	Cognitive behavioural intervention with supported exercise and nutrition	6 mths	D: TMD (POMS) BI: MBSRQ (BAS)	Improved BAS and TMD Relationship with weight loss not assessed but change in psychological outcomes associated with attendance which was associated with weight loss
Arrebola et al. (2011)	14	Overweight/obese males and females aged 18–50 (mean = 40 ± 9 years)	32.09 ± 2.98	60	Lifestyle modification program (diet, exercise and psychological support)	6 mths	HRQOL: SF-36	Improved vitality Relationship with weight loss not assessed but intervention led to significant weight loss
Bacon et al. (2002)	12	Obese females aged 30–45 (mean = 39.3 ± 4.5 years)	35.7 ± 3.6	78	Randomised trial of traditional weight loss (TWL) intervention versus a 'non-diet' (ND)	6 mths and 1 yr follow up	SE: RSE D: BDI BI: BIAQ	Improved SE at 6 mths in TWL but not 12 mths, ND improved SE at 12 mths. D improved at both 6 and 12 mths. BI improved in both TWL and ND at both 6 and 12 mths (greater effect in ND) Effects observed in both groups but only TWL lost weight
Blissmer et al. (2006)	15	Overweight/obese males and females aged 18+ (mean = 50.2 ± 9.2 years)	32.5 ± 3.8	144	Lifestyle modification program	6 mths (with follow up at 12 and 24 mths)	HRQOL: SF-36	Improved vitality and mental health Effects concurrent with weight loss at 6 mths but maintained despite some weight regain at 12 and 24 mths with no difference between weight losers and weight re-gainers
Brodie and Slade (1990)	12	Overweight females (mean = 42.95 ± 10.26 years)	*Not reported*	91	Diet or lifestyle with high or low support (program guidance and counseling)	10 wks	D: BDI BI: BSS	Improved D in both interventions but higher D in high support lifestyle. Improved BI in both interventions but higher BI in high support diet High support diet condition experienced greatest weight loss Improvement in D correlated with weight loss post intervention
Faulconbridge et al. (2009)	14	Obese males and females (mean = 43.7 ± 10.2 years)	37.6 ± 4.1	194	Comparison of four conditions; (i) lifestyle, (ii) pharmacological treatment (sibutramine), (iii) pharmacological treatment and lifestyle combined, (iv) pharmacological treatment and brief lifestyle	40 wks with follow up at wk 52	D: BDI-II	D improved but no difference between treatment groups Relationship between psychological measures with weight loss not assessed but concurrent with weight loss in all groups
Fontaine et al. (1999)	15	Mild-moderately overweight males and females aged 21-45 (mean = 36.5 ± 5.8 years)	33.1 ± 2.1	38	Lifestyle modification program	13 wks	D: BDI	Improved vitality and mental health (*change in D not reported*)
							HRQOL: SF-36	Change in HRQOL concurrent with weight loss
Foster et al. (1997)	13	Obese females (mean = 40 ± 8.7 years)	36.3 ± 4.3	59	Cognitive-behavioural weight reduction program	48 wks	SE: RSE D: BDI BI: MBSRQ (A and BAS)	Improved BI (BAS, A) Changes in BI not related to changes in weight, no difference between weight losers and weight gainers. SE and D only assessed in relation to BI with no relationship post intervention
Harrison,	16	Overweight/obese males and	35.7 ± 7.8	319	Lifestyle modification program	12 wks	HRQOL:	Improved vitality and mental

Table 2 (*continued*)

Reference	QA	Sample	BMI (kg/m^2)	*N*	Intervention	Duration	Measures	Outcome
Mattson, Durbin, Fish, and Bachman (2012)		females (mean = 55.1 ± 11.3 years)					SF-36	health Relationship with weight loss not assessed but effects concurrent with weight loss
Hope et al. (2010)	13	Obese male and female African Americans aged 25-70 (mean = 46.5 ± 9.7 years)	Median Males: 36.4; Females: 36.6	87	Initial lifestyle weight loss program (Phase 1) followed by three weight maintenance programs (Phase 2)	Phase 1 10 wks. Phase 2 8-18 mths	HRQoL: SF-36	Phase 1: Improved HRQoL (vitality and mental health) Effects associated with weight loss Phase 2: Effects not maintained
Kolotkin et al. (2009)	14	Obese males and females aged 18+ (mean = 49.5 ± 11.1 years)	35.4 ± 3.8	926	Placebo RCT pharmacological treatment versus control both with diet and exercise program	12 mths	HRQoL: SF-36; IWQOL-Lite; EQ-5D	Improved HRQoL with increasing weight loss Greatest effects with >10% weight loss
Nauta et al. (2001)	13	Overweight/obese females aged 18–50 (mean = 38.6 ± 6.6 years)	33 ± 4.2	60	Cognitive versus behavioural intervention	6 mths 12mth follow up	SE: RSE D: BDI	Both interventions improved SE and D maintained at 1-year follow up. Cognitive intervention marginally better for D Effects unrelated to weight at 12-mths
Palmeira et al. (2009)	15	Overweight/obese females aged 24+ (mean = 38.4 ± 6.7 years)	31.1 ± 4.1	193	Behavioural intervention versus control (general health education program)	12 mths	SE: RSE D: BDI HRQoL: IWQOL-Lite BI: BIA, BSQ	Improved SE, D, BI and HRQoL Improvements in SE, BI and HRQoL dependent on weight loss
Palmeira et al. (2010)	15	Overweight/obese females aged 24+ (mean = 38.3 ± 5.8 years)	30.2 ± 3.7	142	Behavioural intervention	4 mths 12mth follow up	BI: BIA, BSQ and PSPP SE: RSE D: BDI	Improved BI, D and SE after 4-mths BI and D associated with weight change
Paxman, Hall, Harden, O'Keeffe, and Simper (2011)	14	Obese males and females (mean = 45.63 ± 11.76 years)	37.29 ± 5.05	40	Behavioural weight loss intervention ("Small Changes" progressive treatment)	24 mths	D: TMD (POMS) GWB	Improved psychological wellbeing and reduced TMD Relationship with weight loss not assessed but effects concurrent with weight loss
Rippe et al. (1998)	16	Overweight females aged 20–49 (mean = 37.4 ± 7.9 years (Intervention); 35.6 ± 5.9 years (control))	Control: 29.4 Intervention: 31 (*SD not given*)	44	Commercial weight loss program versus control (maintain normal diet and exercise)	12 wks	SE: RSE D: POMS HRQoL: SF-36 BI: BCS	Improved SE, BI and HRQoL compared to control. Decreased TMD in intervention group. Effects not correlated with amount of weight lost
Steinhardt et al. (1999)	13	Males and females (*age not specified*)	*Not given*	357	Traditional weight loss (TWL) versus 'non-diet'(ND)	10 wks 12mth follow up	SE: RSE BI: BPS	Both interventions improved BI and SE. Effects maintained at 12 mths Relationship with weight loss not assessed
Styn et al. (2012)	13	Overweight/obese females aged 18-59 (mean = 46.9 years *SD not given*)	34.1 (*SD not given*)	191	Behavioural intervention ('SMART' trial)	24 mths	HRQoL: SF-36	>5% weight loss associated with increased vitality and mental health
Swencionis et al. (2013)	14	Overweight/obese males and females (mean = 52.2 ± 11.7 years)	35.6 ± 6.54	588	Behavioural weight loss intervention differing in intensity of support (workbook versus computer versus computer and staff)	12 mths	HRQoL: PWI	Weight loss associated with improved psychological wellbeing and vitality
Teixeira et al. (2006)	15	Overweight/obese females aged 40–55 (mean = 48.1 ± 4.4 years)	30.6 ± 5.6	136	Behavioural weight-loss intervention	16 wks 12 mths follow up	BI: BSQ and PSPP	Improved BI at 16 wks in successful completers Effects correlated with weight loss
Teixeira et al. (2010)	15	Overweight/obese females 25–50 (mean = 37.6 ± 7.0 years)	31.3 ± 4.1	225	Behavioural 12 mths intervention versus 12 mths control (general health advice) (RCT)	24 mths	BI: BSQ and PSPP	Improved BI at 12 mths. Effects correlated with weight loss. Effects maintained 12 mths post intervention
Wadden et al. (1992)	11	Obese females (mean = 42.1 ± 1.1 years)	39.4 ± 0.8	76	Three treatment conditions: (i) VLCD; (ii) behavior therapy; (iii) VLCD + behaviour therapy	4 wks and 1 yr follow up	D: BDI	Higher D with greater weight loss (but no pre-post assessment)

(*continued on next page*)

Table 2 (*continued*)

Reference	QA	Sample	BMI (kg/m^2)	*N*	Intervention	Duration	Measures	Outcome
Yankura et al. (2008)	12	Overweight and obese females aged 52–62 (weight loss mean = 55.9 ± 2.8 year; weight stable mean = 57.3 ± 2.9 year; weight regain mean = 56.8 ± 3.1 year)	Weight loss mean = 31.7 ± 3.7; Weight stable mean = 30.3 ± 3.8; Weight regain mean = 3.0 ± 3.7	284	Lifestyle change (LC) versus Health Education group (HE) considered in terms of those who lost weight (WL), maintained weight (WS) and regained weight (WR)	18 mths	HRQoL: SF-32	Improvement in HRQoL (social functioning) between baseline and 6 mths for WL and WS but decline for WR concurrent with weight loss in all groups Improved HRQoL (social functioning) in WR concurrent with weight regain but declining HRQoL in WL and WS

Note: only aspects of studies relevant to review are included. SE = Self-esteem; D = depressive symptoms; BI = body image; HRQoL = health related quality of life; RCT = randomised controlled trial; LCD = low calorie diet; VLCD = very low calorie diet.
BCS = Body Cathexis Scale; BDI = Beck Depression Inventory; BIA = Body Image Assessment; BSQ = Body Shape Questionnaire; BSS = Body Satisfaction Scale; GWB = General Wellbeing Scale; IWQOL-Lite = Impact of Weight on Quality of Life – Lite Questionnaire; MBSRQ = Multidimensional Body Self-Relations Questionnaire (A = Appearance subscale, BAS = body areas satisfaction subscale); POMS = Profile of Mood States (TMD = Total Mood Disturbance); PSPP = Physical Self- Perception Profile; PWI = Psychological Wellbeing Index; RSE = Rosenberg Self-Esteem Scale; SF-36 = Medical Outcomes Survey Short Form (36) Health Survey.

Tabulation of studies

Tables 2 and 3 summarise the main characteristics of each study by type of intervention. Interventions were categorised in terms of their primary characteristics and two main types of intervention emerged: (i) behavioural or lifestyle ($n = 25$) (Table 2) and (ii) diet/caloric restriction with or without exercise ($n = 11$) (Table 3). Gender, age and BMI (mean and standard deviation) are included where available. The nature of the intervention is documented together with the duration of treatment, measures used to assess psychological change and corresponding outcomes.

Quality assessment

An 18-item quality assessment tool, which covered key elements of study aims and design, sample selection, weight loss intervention, controls, analysis and outcomes was devised (Appendix A). This tool was an adaptation of a similar tool used in a previous systematic review (Hoyland, Dye, & Lawton, 2009). All criteria were equally weighted and a score of 1 was obtained if the criterion was satisfied. Each study was rated for quality using the pre-defined assessment criteria. A random sample of studies ($n = 13$) was reviewed by two further authors independently. Discrepancies in ratings were discussed by all authors to reach consensus. Inter-rater reliability (IRR) was assessed using a two way mixed, absolute agreement single measures Intra-class correlation coefficients (ICC) for each pair and averaged to provide a single index of IRR. The resulting ICC indicated a high level of agreement (ICC = 0.934). Quality assessment (QA) ratings appear in Tables 2 and 3. Studies were not excluded on the basis of this measure but considered in terms of quality as a critique.

Results

Four main categories of psychological outcomes emerged: (i) self-esteem, (ii) depressive symptoms, (iii) body image and (iv) health related quality of life (HRQoL). Twelve studies assessed changes in self-esteem, 17 studies assessed changes in depressive symptoms, 14 assessed changes in body image and finally, 17 assessed changes in health related quality of life (focussing only on psychological rather than physical outcomes and incorporating mental health and vitality) using a variety of measures. Fifteen of the studies included in the review assessed more than one psychological outcome.

Effect sizes

Where data were provided, effect sizes using Hedges' g standardised mean difference (Hedges & Olkin, 1985) were calculated to indicate the magnitude of change pre- to post- intervention for each psychological outcome (depression, self-esteem, HRQoL and body image). These results are presented in Tables 4–7. Effect sizes were not pooled with meta-analysis due to heterogeneity of design of studies. Data were not available to calculate effect sizes in 11 of the 36 papers included in the review.

Quality assessment

A quality assessment was conducted on each study included in the current review to provide a measure of the standard of methodology adopted and serve as a critique of the study outcomes. Quality scores ranged from 11 to a maximum of 17 out of a possible 18 (mean of 14 ± 1.35) with 27 of the 36 studies included in the review achieving a quality score of between 13 and 15. The assessment indicated an acceptable standard of quality; however, no study fulfilled all the criteria specified to achieve a maximum quality score.

In terms of study design, only five out of the 36 studies were randomised controlled trials (RCTs). Of the remaining studies, only a further four included a comparison group or control condition. Consequently, a high number of studies failed to score on important design characteristics such as sample selection, counterbalancing and blinding. A high proportion of studies ($n = 34$) also failed to account for measures of adherence and compliance to the intervention. No difference in quality was observed when comparing the different types of weight loss intervention, however, the two studies that included a 'non-diet' intervention were judged to be of a slightly lower quality.

Self-esteem

Of the 36 studies included in the review, twelve studies assessed changes in self-esteem following completion of a weight loss intervention with eleven of these studies exploring self-esteem in conjunction with more than one psychological outcome. All of the studies included in the review utilised the Rosenberg Self Esteem Scale (RSES; Rosenberg (1965). The majority of studies assessed change in self-esteem following completion of a behavioural intervention ($n = 8$) with two of these studies utilising a behavioural intervention compared with a 'non-diet' approach and four studies assessing changes following a standard dietary intervention with or without exercise. Improvement in self-esteem was consistently noted, with ten of the twelve studies reporting improvements in self-esteem following completion of the intervention. One study, however, observed no change (Bryan & Tiggemann, 2001) and in one paper self-esteem outcomes were not reported (Foster, Wadden, & Vogt, 1997). Effect sizes varied

Table 3
Psychological outcomes following interventions which focused on diet/caloric restriction with or without exercise ($n = 11$).

Reference	QA	Sample	BMI (kg/m^2)	*N*	Intervention	Duration	Measures	Outcome
Bas and Donmez (2009)	14	Overweight/obese Turkish males and females aged 22–56 (mean = 35.51 ± 8.73; 34.81 ± 9.21 years respectively)	Males: 31.24 ± 3.65; females: 29.12 ± 5.08	96	Commercial weight reduction program (caloric restriction, nutrition education, exercise)	20 wks	SE: RSE BI: BPSS	Improved SE and BI (body satisfaction) Effects concurrent with weight loss (but did not correlate with weight loss)
Bryan and Tiggemann (2001)	15	Overweight females (mean intervention = 48.9 ± 8.2 years; control = 50.9 ± 7.3 years)	Intervention: 34.1 ± 4.3; control: 35.2 ± 4.8	63	Prescribed weight reduction intervention versus control (maintain normal diet and exercise)	12 wks	SE: RSE D: POMS	Improved D. No change in SE Effects not correlated with weight loss post intervention
Imayama et al. (2011)	17	Overweight/obese females aged 50–75 (mean = 57.4 ± 4.4 (control); 58.1 ± 5.9 (diet); 58.1 ± 5.0 (exercise); 58 ± 4.5 (diet and exercise)	Control: 30.7 ± 3.9; diet: 31 ± 3.9; exercise: 30.7 ± 3.7; diet and exercise: 31 ± 4.3	439	RCT: diet versus exercise versus diet and exercise versus control (maintain normal diet and exercise)	12 mths	HRQoL: SF-36	Diet and exercise improved HRQoL (vitality and mental health). Diet alone improved HRQoL (vitality) compared with control. No effect of exercise alone compared with control Effects associated with weight loss
Kiernan et al. (2001)	14	Overweight/obese males and females aged 25–49 (mean = 38.5 ± 6.4 years)	Males: control: 30.7 ± 2.2; diet: 30.4 ± 2.1; diet and exercise: 30.7 ± 2.1 females: control: 28.1 ± 2.4; diet: 28 ± 2.1; diet and exercise: 28 ± 2.4	231	Diet versus exercise versus diet and exercise versus control (RCT)	12 mths	D:BDI BI:BDS of EDI	No improvement in D. Improved body dissatisfaction in males Effects correlated with amount of weight lost and not intervention type
Lim et al. (2009)	15	Overweight/obese females aged 17-37 (mean = 28 ± 0.3 years)	33.3 ± 0.3	203	Prescriptive diet and exercise versus general lifestyle advice.	12 wks	SE: RSE	Improved SE with prescriptive diet Effects independent of weight lost
Messier et al. (2010)	15	Overweight/obese females (mean = 58 ± 4.7 years (CR); 57.2 ± 5.0 years (CR/RT)	CR: 32.2 ± 4.6 CR/RT: 32.6 ± 4.9	107	Caloric restriction (CR) versus caloric restriction with resistance training (CR/RT)	6 mths	SE:RSE BI: BES QOL: MOSGHS	Improved body esteem and SE. No difference between groups Change in BI correlated with weight loss
Pan et al. (2011)	14	Overweight/obese males and females aged 20-65 (mean = 39.6 ± 10.3 years)	32.8 ± 4.4	38	Weight loss intervention (diet and exercise)	3 mths	HRQoL: WHOQOL-BREF	Improved HRQoL with weight loss of >5% but only on physiological aspects of HRQoL
Vasiljevic et al. (2012)	14	Overweight/obese Serbian males and females aged 18+ (mean = 41.8 ± 12.9 years)	36.2 ± 5.3	135	Diet-induced weight loss with behavioural modification and exercise	12 mths	HRQoL: IWQOL-Lite	Improved SE with smaller weight reduction Bigger improvements in HRQoL with greater reductions in weight
Wadden et al. (1997)	15	Obese females (mean = 41.1 ± 8.6 years)	36.5 ± 5.1	128	Four treatment conditions: (i) diet alone; (ii) diet plus aerobic training; (iii) diet plus strength training; (iv) combined diet, aerobic and strength	48 wks	D:BDI, POMS	No differences in D
Wu et al. (2009)	13	Obese males and females aged 18-54 (mean = 35.2 ± 1 year)	33.5 ± 0.4	119	Four treatment conditions: (i) LCD; (ii) LCD+sibutramine; (iii) LCD+orlistat; (iv) VLCD	6 mths	HRQoL: SF-36 (Chinese version)	Greater improvements in HRQoL with weight loss >15%. No changes observed with weight loss <5%. Improvements greater in females
Yancy et al. (2009)	13	Overweight males and females 18–65 (mean = 44.2 ± 10.1 LCKD; 45.6 ± 9.0 years LFD)	LCKD: 34.6 ± 4.9 LFD: 34 ± 5.1	119	Low carbohydrate, ketogenic diet (LCKD) versus low fat diet (LFD)	24 wks	HRQoL: SF-36	Improved HRQoL (vitality) in both groups. HRQoL (mental health) improved in LCKD only Relationship with weight loss not assessed but greater weight loss in LCKD

Note: only aspects of studies relevant to review are included. SE = self-esteem; D = depressive symptoms; BI = body image; HRQoL = health related quality of life; RCT = randomised controlled trial BDI = Beck Depression Inventory; BES = Body Esteem Scale; BPSS = Body Parts Satisfaction Scale; EDI = Eating Disorders Inventory (BDS: Body Dissatisfaction Scale); IWQOL-Lite = Impact of Weight on Quality of Life – Lite Questionnaire; MOSGHS: Medical Outcomes Survey General Health Survey; POMS = Profile of Mood States (TMD = Total Mood Disturbance); RSE = Rosenberg Self-Esteem Scale; SF-36 = Medical Outcomes Survey Short Form (36) Health Survey; WHOQOL-BREF = World Health Organisation Quality of Life-BREF.

considerably, ranging from little or no effect to substantial improvements in self-esteem with both behavioural and standard dietary interventions with or without exercise interventions (see Table 4). Calculation of effect sizes was not possible for two studies (Foster et al., 1997; Lim, Norman, Clifton, & Noakes, 2009). Of those studies which observed an improvement in self-esteem, only one found the change in self-esteem to be significantly correlated with amount of weight lost (Palmeira et al., 2009) whereby greater weight loss was associated with greater improvements in self-esteem. Of the remaining nine studies, five found no association between the amount of weight lost and change in self-esteem and four studies did not directly assess the relationship. However, in these studies, improvement in self-esteem was concurrent with weight loss as a result of the intervention (Ames et al., 2005; Bas & Donmez, 2009) with the exception of two studies which included a 'non-diet' intervention arm (Bacon et al., 2002; Steinhardt, Bezner, & Adams, 1999). Bacon et al. (2002) observed an improvement in self-esteem outcomes following completion of both a behavioural intervention and a non-diet alternative despite the observation that the non-diet did not lead to weight loss. Also, Steinhardt et al. (1999) observed that neither intervention led to weight loss but improvements in self-esteem were still observed with both interventions. Both of these studies were supported with medium effect sizes for the magnitude of change.

Depressive symptoms

Seventeen studies assessed changes in depression following completion of a weight loss intervention. The majority of studies reviewed assessed depression using the Beck Depression Inventory (BDI (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961)). However, six studies utilised the Total Mood Disturbance (TMD) score of the Profile of Mood States (POMS (McNair, Lorr, & Droppleman, 1971)) (with one study utilising both measures). Fourteen studies assessed changes following completion of a behavioural intervention and three after completion of a standard dietary intervention with or without exercise.

Of the seventeen studies, one study observed no change in depressive symptoms (Kiernan, King, Stefanick, & Killen, 2001) and two did not report depression related outcomes despite measurement (Fontaine et al., 1999; Foster et al., 1997). All remaining studies observed a reduction in depressive symptoms (n = 14). Again, calculated effect sizes varied considerably with small, medium and large effects noted in both standard dietary interventions with or without exercise and behavioural interventions (see Table 5). Calculation of effect sizes was not possible for four studies (Fontaine et al., 1999; Foster et al., 1997; Kiernan et al., 2001; Wadden et al., 1992). Of the eight studies that directly assessed the relationship between amount of weight loss and reduction in depressive symptoms, only three studies reported a significant positive relationship between weight loss and degree of improvement.

Body image

Fourteen studies assessed changes in body image following completion of a weight loss intervention. Unlike self-esteem and depression, body image encompassed a variety of forms including body dissatisfaction, appearance evaluation, body shape concerns, image avoidance and body esteem. Consequently, body image was assessed using a number of different measures with a total of eleven different measures utilised across fourteen studies (see Table 2). Eleven of the studies assessing changes in body image utilised a behavioural intervention, with three utilising a standard dietary intervention with or without exercise. Despite the differences in interventions and measures, all of the studies included in this review observed improvements in measures of body image, consistently demonstrating that participation in a weight loss intervention can improve body image scores. In support of this, calculated effect sizes were more consistent than for self-esteem and depression and revealed more medium and large effects (see Table 6). Calculation of effect sizes was not possible for one study (Kiernan et al., 2001). No consistent pattern emerged, however, in terms of whether behavioural interventions were more effective than standard dietary interventions with or without exercise. Further, unlike self-esteem and depression, improvements in body image were more closely related to amount of weight lost with almost half of the studies assessing this outcome (n = 6) demonstrating a significant correlation between improvement in body image and the amount of weight lost. However, of the remaining studies (n = 8), one study (Foster et al., 1997) observed no differences between those who had lost weight or gained weight in terms of improvement in body image following completion of a behavioural intervention. Bas and Donmez (2009) and Rippe et al. (1998) found improvements in body image to be concurrent with the amount of weight lost but not directly correlated with weight loss. The remaining five studies did not directly assess the relationship between weight lost and improvement in body image, although, as observed previously, improvements were concurrent with weight loss as a result of the intervention.

Health related quality of life

Seventeen studies assessed changes in health related quality of life (HRQoL) following completion of a weight loss intervention. Eleven studies assessed changes in HRQoL following completion of a behavioural intervention and six studies employed a standard dietary intervention with or without exercise. Health-related quality of life (HRQoL) refers to a person's perception of their own physical, psychological and social functioning incorporating well-being, signs and symptoms of health and disease including coping and, perhaps of greater relevance to obesity, perceptions such as stigma (Maciejewski, Patrick, & Williamson, 2005; Sullivan, Sullivan, & Kral, 1987). Given the multi-dimensional nature of HRQoL, a distinction was made between the physical and psychological aspects and emphasis placed on psychological outcomes. All seventeen studies observed an improvement in general HRQoL but only fifteen observed specific improvements in psychological aspects of HRQoL. Of the different domains assessed by HRQoL measures, vitality emerged as the domain most likely to improve following completion of a weight loss intervention. Calculated effect sizes varied across the studies assessing HRQoL, ranging from little or no effect to very large effects (see Table 7). Calculation of effect sizes was not possible for eight studies (Blissmer et al., 2006; Hope, Kumanyika, Shults, & Holmes, 2010; Kolotkin et al., 2009; Pan, Cole, & Geliebter, 2011; Styn et al., 2012; Vasiljevic, Ralevic, Kolotkin, Marinkovic, & Jorga, 2012; Yancy et al., 2009; Yankura et al., 2008). Behavioural interventions (with the exception of Swencionis et al., 2013) appeared to produce marginally better effect sizes over standard dietary intervention with or without exercise interventions. Further, effect sizes supported the tendency for vitality to show the most improvement. Of the four psychological outcomes that emerged from this review, HRQoL had the strongest association with amount of weight lost. Nine studies observed a significant association between improvement in vitality and mental health scores and amount of weight lost. Four of these studies indicated that improvements were dependent on weight losses greater than 5% with greater improvement observed with weight loss of more than 10% of initial body weight. Interestingly, one study observed a decline in social functioning despite significant weight loss during the intervention phase (Yankura et al., 2008). The authors attributed this to the possibility that eating behaviour was closely tied to social activities in this population

Table 4
Magnitude of pre- to post-intervention changes in self-esteem based on effect sizes and 95% confidence intervals.

Reference	Duration	Intervention	Hedges g[a]	95% Confidence interval	
				Lower bound	Upper bound
Ames et al. (2005)	10 wks	Behavioural (SB)	−0.01	−3.01	3.03
		Behavioural (RCB)	−0.63	−1.43	2.70
Bacon et al. (2002)	6 mths	Behavioural (TWL)	−0.35	−2.08	1.38
		Comparison (ND)	−0.32	−1.52	0.88
Bas and Donmez (2009)	20 wks	Diet/caloric restriction (males)	−2.34	−3.02	−1.66
		Diet/caloric restriction (females)	−1.92	−2.36	−1.48
Bryan and Tiggemann (2001)	12 wks	Diet/caloric restriction	0.16	−1.16	1.48
		Control	0.15	−2.39	2.69
Messier et al. (2010)	6 mths	Diet/caloric restriction	−0.25	0.18	0.31
		Diet/caloric restriction (with RT)	−0.66	0.59	0.73
Nauta et al. (2001)	6 mths	Behavioural (BT)	−0.07	−1.89	2.02
		Behavioural (CT)	−0.81	−1.06	2.68
	12 mths	Behavioural (BT)	−0.19	−1.68	2.05
		Behavioural (CT)	−0.42	−1.81	2.65
Palmeira et al. (2009)	12 mths	Behavioural	−0.52	−1.03	−0.01
		Comparison	−0.30	−1.15	0.55
Palmeira et al. (2010)	4 mths	Behavioural	−0.17	−0.72	0.37
Rippe et al. (1998)	12 wks	Behavioural	−0.81	−0.31	1.92
		Control	−0.03	−3.49	3.55
Steinhardt et al. (1999)	10 wks	Behavioural (males)	−0.58	−1.84	0.69
		Comparison (ND) (males)	−0.44	−1.91	1.02
		Behavioural (females)	−0.53	−1.80	0.74
		Comparison (ND) (females)	−0.47	−1.79	0.86

[a] A negative ES indicates an increase in self-esteem.

which reduced as a result of the intervention. Of perhaps greater interest, is the finding that these individuals went onto regain weight in the latter stages of the intervention, indicating that early decline in certain psychological outcomes (e.g. social functioning) may predict long-term weight loss failure. Unfortunately, the magnitude of this effect could not be assessed as the data to calculate effect sizes were not available. Of the remaining studies, six did not directly assess this relationship but effects were concurrent with weight loss following completion of the intervention. The majority of studies assessing HRQoL utilised the Medical Outcomes Study Short Form (36) Health Survey (MOS SF-36 (Ware & Sherbourne, 1992)). However, three studies utilised the Impact of Weight on Quality of Life (IWQOL-Lite (Kolotkin, Crosby, Kosloski, & Williams, 2001)) which is an obesity specific quality of life measure.

Discussion

The benefits of weight loss are well documented but with greater emphasis on physiological benefits and less emphasis on the psychological benefits. The majority of previous research has focussed on weight loss as the primary outcome with less emphasis on psychological benefit. Therefore, this systematic review focussed on studies which employed a behavioural and/or dietary weight loss intervention (with or without exercise) in a sample of overweight to moderately obese individuals. A review of 36 studies revealed positive psychological changes post intervention in the majority of studies reviewed. Specifically, pre-post intervention improvements in self-esteem, depressive symptoms, body image and health-related quality of life (HRQoL; mental health and

Table 5
Magnitude of pre- to post- intervention changes in depression based on effect sizes and 95% confidence intervals.

Reference	Duration	Intervention	Hedges g[a]	95% Confidence interval	
				Lower bound	Upper bound
Ames et al. (2005)	10 wks	Behavioural (SB)	0.10	−2.19	2.38
		Behavioural (RCB)	0.45	−1.36	2.26
Annesi and Gorjala (2010)	6 mths	Behavioural	0.50	−1.80	2.79
Annesi and Whitaker (2010)	6 mths	Behavioural	0.27	−0.08	0.63
Bacon et al. (2002)	6 mths	Behavioural (TWL)	0.65	−1.92	3.21
		Comparison (ND)	0.49	−1.38	2.36
Brodie and Slade (1990)	10 wks	Behavioural	0.23	−0.65	1.10
Bryan and Tiggemann (2001)	12 wks	Diet/caloric restriction	0.39	−1.14	1.91
		Control	−0.13	−3.74	3.48
Faulconbridge et al. (2009)	40 wks	Behavioural	0.37	−0.28	1.02
Nauta et al. (2001)	6 mths	Behavioural (BT)	0.07	−1.77	1.91
		Behavioural (CT)	0.50	−1.08	2.08
	12 mths	Behavioural (BT)	0.09	−1.66	1.84
		Behavioural (CT)	0.65	−1.11	2.41
Palmeira et al. (2009)	12 mths	Behavioural	0.48	−0.04	1.01
		Comparison	0.73	−0.08	1.54
Palmeira et al. (2010)	4 mths	Behavioural	0.42	−0.29	1.13
Paxman, Hall, Harden, O'Keeffe, and Simper (2011)	12 wks	Behavioural	0.95	−5.02	6.92
Rippe et al. (1998)	12 wks	Behavioural	0.88	−0.46	2.22
		Control	0.22	−2.74	3.18
Wadden et al. (1997)	48 wks	Diet/caloric restriction	1.28	0.54	2.01

[a] A positive ES indicates a reduction in depressive symptomology.

Table 6
Magnitude of pre- to post- intervention changes in body image based on effect sizes and 95% confidence intervals.

Reference	Duration	Intervention	Measure	Hedges g[a]	95% Confidence interval	
					Lower Bound	Upper Bound
Ames et al. (2005)	10 wks	Behavioural (SB)	AS	0.18	−3.97	4.33
		Behavioural (SB)	BAS	−0.73	−2.31	0.84
		Behavioural (RCB)	AS	0.44	−2.23	3.12
		Behavioural (RCB)	BAS	−0.77	−2.22	0.67
Annesi and Whitaker (2010)	6 mths	Behavioural	BAS	−0.66	−0.98	−0.34
Bacon et al. (2002)	6 mths	Behavioural (TWL)	BIAQ	0.49	−2.07	3.04
		Comparison (ND)		0.97	−1.18	3.12
Bas and Donmez (2009)	20 wks	Diet/caloric restriction (males)	BPSS	−0.33	−4.38	3.73
		Diet/caloric restriction (females)		−0.23	−2.05	1.59
Brodie and Slade (1990)	10 wks	Behavioural	BSS	0.32	−1.98	2.63
Foster et al. (1997)	48 wks	Behavioural	AS	−1.37	−1.51	−1.22
			BAS	−1.19	−1.30	−1.08
Messier et al. (2010)	6 mths	Diet/caloric restriction	BES	−0.43	−0.54	−0.31
		Diet/caloric restriction (with RT)		−0.72	−0.84	−0.59
Palmeira et al. (2009)	12 mths	Behavioural	BIA	1.14	1.06	1.22
		Behavioural	BSQ	0.75	−2.37	3.88
		Comparison	BIA	0.37	0.21	0.53
		Comparison	BSQ	0.59	−4.00	5.18
Palmeira et al. (2010)	4 mths	Behavioural	BIA	0.52	0.41	0.63
			BSQ	0.33	−3.25	3.90
			PSPP	−0.41	−0.82	0.01
Rippe et al. (1998)						
	12 wks	Behavioural	BCS	1.03	−3.50	5.56
		Control		0.05	−5.14	5.23
Steinhardt et al. (1999)	10 wks	Behavioural (males)	BPS	0.42	−0.59	1.43
		Comparison (ND) (males)		0.53	−0.69	1.75
		Behavioural (females)		−0.47	−1.90	0.97
		Comparison (ND) (females)		0.42	−0.54	1.38
Teixeira et al. (2006)	4 mths	Behavioural	BSQ	0.94	−2.20	4.09
			PSPP – physical self worth	−0.91	−0.98	−0.85
			PSPP – attractiveness	−0.85	−0.91	−0.78
Teixeira et al. (2010)	12 mths	Behavioural	BSQ	1.36	−1.72	4.43
		Behavioural	PSPP – physical self worth	−0.61	−1.07	−0.14
		Behavioural	PSPP – attractiveness	−0.80	−1.27	−0.34
		Behavioural	BIA	1.35	1.25	1.46
		Control	BSQ	0.48	−3.26	4.22
		Control	PSPP – physical self worth	−0.54	−1.06	−0.02
		Control	PSPP – attractiveness	−0.42	−0.88	0.04
		Control	BIA	0.69	0.57	0.80

[a] A negative score indicates improvement in body image using BES, BIA and PSPP. A positive score indicates improvement in body image using BSQ, BCS, BAS, AS and BSS.

vitality) were consistently noted. Effect sizes supported these observations with medium to large effects noted but with substantial variation across outcomes and interventions employed.

Improvements in psychological outcomes following completion of a weight loss intervention are thought to be direct consequences of weight loss. Indeed, for some outcomes assessed in this review, weight loss positively correlated with the degree of psychological improvement. This was particularly pertinent for measures of body image and health related quality of life (HRQoL). Given that the stigma obesity carries is directly related to body weight and shape, it is not surprising that body image is an outcome sensitive to change following weight loss. Weight loss permits the individual to 'see' physical changes and improvements, which in turn improve body esteem. Reciprocal effects were in fact observed in one study reviewed, whereby weight loss mediated improvement in body image which in turn reduced body image concerns thus improving the chances of weight loss (Palmeira et al., 2009).

Of all the psychological HRQoL domains assessed, vitality was the most responsive to weight loss (Hope et al., 2010; Yancy et al., 2009). Vitality increased with weight loss (Fontaine et al., 1999; Kolotkin et al., 2009) with effects maintained at 1 year follow up when weight loss was also maintained (Vasiljevic et al., 2012). To permit significant changes in the various domains of HRQoL that are clinically relevant it has been suggested that a minimum weight change is required (Ross & Bradshaw, 2009). A minimum threshold of 5% weight loss was evident from the studies included in this review and this is consistent with suggestions from previous research (Hwu, 2011; Ross & Bradshaw, 2009). Less than a 5% reduction in weight is associated with little improvement and changes of greater than 15% are associated with much greater improvements in HRQoL (Wu, Kuo, Chang, & Yu, 2009). Indeed, one of the studies included in this review observed a 5% decrease in weight to be associated with an almost 10% increase in vitality and a 3% increase in mental health (Styn et al., 2012). Further, Vasiljevic et al. (2012) observed significant improvements on all domains of the Impact of Weight on Quality of Life-Lite scale (IW-QOL-Lite) with a 10% reduction in weight. However, given that changes have also been observed without concurrent weight loss it is not clear where, or if, a recommended threshold should be set. Further, studies considered in this review varied in terms of how weight loss was quantified. Some studies reported actual weight loss in pounds (lbs) or kilograms (kg) and others reported percentage weight loss. Some consistency in how weight loss is defined (and reported) is, therefore, required to permit comparison of outcomes across studies.

For some psychological outcomes, however, weight loss may not always be a prerequisite for improvement in psychological benefit. Some of the studies reviewed noted improvements in psychological outcomes in the absence of weight loss (Bryan & Tiggemann, 2001; Lim et al., 2009; Nauta, Hospers, & Jansen, 2001; Rippe et al., 1998) and sometimes with weight gain (Blissmer et al., 2006; Nauta et al., 2001). However, such findings were associated with only small effect sizes and should be treated with caution. Conversely, one study noted a decline in psycholog-

Table 7
Magnitude of pre- to post- intervention changes in health related quality of life (HRQoL) based on effect sizes and 95% confidence intervals.

Reference	Duration	Intervention	Measure	Hedges g[a]	95% Confidence interval	
					Lower Bound	Upper Bound
Arrebola et al. (2011)	6 mths	Behavioural	Vitality	−0.49	−6.99	6.01
Fontaine et al. (1999)	13 wks	Behavioural	Vitality	−1.31	−5.08	2.46
			Mental Health	−0.52	−3.27	2.23
Harrison et al. (2012)	12 wks	Behavioural	Vitality	−0.70	−1.45	0.05
			Mental Health	−0.36	−1.29	0.57
Imayama et al. (2011)	12 mths	Diet/Caloric Restriction (Control)	Vitality	−0.11	−2.63	2.42
		Diet/Caloric Restriction (Diet)	Vitality	−0.52	−2.75	1.71
		Diet/Caloric Restriction (Exercise)	Vitality	−0.15	−2.33	2.02
		Diet/Caloric Restriction (Diet and Exercise)	Vitality	−0.64	−2.94	1.66
		Diet/Caloric Restriction (Control)	Mental Health	−0.01	−2.10	2.07
		Diet/Caloric Restriction (Diet)	Mental Health	−0.26	−1.92	1.41
		Diet/Caloric Restriction (Exercise)	Mental Health	−0.01	−1.40	1.39
		Diet/Caloric Restriction (Diet and Exercise)	Mental Health	−0.26	−1.85	1.34
Messier et al. (2010)	6 mths	Diet/Caloric Restriction	Mental Health	−0.22	−2.60	2.16
		Diet/Caloric Restriction (with RT)		−0.11	−3.70	3.48
Palmeira et al. (2009)	12 mths	Behavioural	IWQOL-L	−0.62	−2.01	0.76
		Comparison		−0.64	−3.23	1.95
Rippe et al. (1998)	12 wks	Behavioural	Vitality	−1.35	−5.36	2.67
		Control	Vitality	0.14	−7.00	7.28
		Behavioural	Mental Health	−0.71	−4.38	2.97
		Control	Mental Health	0.13	−6.41	6.66
Swencionis et al. (2013)	6 mths	Behavioural	Vitality	0.00	−0.25	0.25
	12 mths			−0.14	−0.36	0.08
Wu et al. (2009)	6 mths	Diet/Caloric Restriction (Overall)	Vitality	−3.38	−3.59	−3.17
			Mental Health	0.38	0.25	0.51
			Mental Health Composite	−0.50	−0.63	−0.37

[a] A negative ES indicates improvement in HRQoL.

ical wellbeing despite significant weight loss but only in those who later regained weight (Yankura et al., 2008). The type of intervention and the outcome in question may, therefore, be important in understanding these effects. The majority of the studies included in this review utilised a standard behavioural or lifestyle modification based intervention while others placed emphasis on caloric restriction and exercise. Increasing self-acceptance, and changing attitudes towards body size and shape, as targeted by most behavioural interventions, may be effective in raising a person's psychological profile in the absence of weight loss. Such interventions place greater emphasis on self-acceptance and disentangling eating behaviour from emotions. Consequently, changes in psychological outcomes may occur without concurrent weight loss. Interventions which comprise some form of dietary restriction (hypocaloric or caloric reduction with exercise) maintain emphasis on controlled eating behaviour and require weight loss as a marker of success. Hence, improved psychological outcome may be tied to actual weight loss. Yet for some, the increased social support and self-acceptance as a result of simply being in an intervention is enough to make someone feel healthier and demonstrate improved psychological wellbeing (Brodie & Slade, 1990).

Interventions in which the emphasis is on diet (e.g. caloric reduction) have also demonstrated improvements in body image but where effects are influenced by actual weight loss. Brodie and Slade (1990) observed an improvement in body satisfaction following completion of a high support diet program, with effects concurrent with greater weight loss. Teixeira et al. (2006) observed improvements in body image (body shape concern, size dissatisfaction, self-worth and attractiveness) following completion of a 4-month lifestyle intervention and observed effects which were significantly correlated with weight change. Teixeira et al. (2010) also observed weight related improvements in body shape concern, size dissatisfaction, self-worth and attractiveness following completion of a 12-month weight management intervention. Rippe et al. (1998), however, observed improved body satisfaction that was not associated with weight loss following a 12-week diet and exercise intervention. Additionally, caloric restriction interventions have shown similar results (Messier et al., 2010) with increases in appearance evaluation and body satisfaction, unrelated to weight loss (Foster et al., 1997). It must be noted, that not all studies included in the review directly assessed the extent of weight loss as a predictor or correlate of improvement in psychological outcome. However, the majority of studies observed improvements that were concurrent with successful weight loss following completion. Despite this, it remains a methodological limitation that should be addressed in future research to elucidate the extent to which psychological improvements are dependent on actual weight loss.

Sixteen of the studies included in this review included some form of dietary or caloric restriction as part of the intervention. Restrictive dietary interventions that are very hypocaloric (i.e. <1200 kcal) have been associated with attrition and poorer psychological outcomes (Polivy & Herman, 1987, 1992; Wooley & Garner, 1991). However, some studies have demonstrated that adherence may actually improve following improvements in wellbeing concurrent with successful weight loss (Rodriguez-Rodriguez, Lopez-Sobaler, Ortega, Aparicio, & Bermejo, 2007). An alternative approach is the 'non-diet' (Polivy & Herman, 1992). The concept of 'non-dieting' reflects a shift away from the 'typical diet' due to its perceived restrictive nature and possible negative connotations. Emphasis is on promoting self-acceptance and self worth that is not dependent on body weight or shape. Participants are educated in diet and nutrition and encouraged to eat in response to the physiological cues for hunger and satiety (without emphasis on dietary restraint). The programs promote physical activity and incorporate social support to promote assertiveness and positive change (Bacon et al., 2002). The results of the non-diet approach have been promising in terms of improved psychological outcomes but often criticised for the lack of a control group comparison and frequent weight gain as a result of treatment (Faith, Fontaine, Cheskin, & Allison, 2000). 'Non-diets' have been shown to produce similar results to other behavioural interventions (Steinhardt et al., 1999) possibly due to some similarity in the components they include. In the current review, two studies included a 'non-diet' comparison (Bacon et al., 2002; Steinhardt et al., 1999). In both

studies, improvement in psychological outcome was reported following both a traditional weight loss intervention and 'non-diet' comparison, supported by medium to large effect sizes. However, no significant change in weight was noted following the 'non-diet' (or the behavioural intervention (Steinhardt et al., 1999)) with a tendency for small weight gain as per previous critiques of this approach (Faith et al., 2000).

It is interesting to note that there is currently a lack of consensus for an agreed set of appropriate outcomes from trial data, including research in nutrition. Initiatives such as COMET (Core Outcome Measures in Effectiveness Trials Initiative) (Williamson and Clarke, 2012) have been setup to develop a 'core outcome set'. Consistent with this and more recent research, it is suggested that the psychological, rather than physiological, outcomes of a behavioural intervention may be of greater importance when determining the success of a program. It is recognised that weight loss alone may be insufficient to indicate longer-term success (Teixeira, Silva, Mata, Palmeira, & Markland, 2012). Specifically, the development of autonomy and self-efficacy as a result of the intervention may be of key importance. This may facilitate the efficacy of the intervention in leading to positive outcomes. Indeed the effective components of behavioural intervention should be identified, clearly defined and distinguished from other types of intervention. In a review by Michie, Abraham, Whittington, McAteer, and Gupta (2009) the element of self-monitoring was found to increase efficacy of the intervention in addition to at least one of Carver and Scheier (1982) control theory elements (e.g. goal setting, feedback). Self-monitoring may, therefore, increase a sense of autonomy. Furthermore, research on 'self-monitoring' (which often coincides with weight loss interventions) has also been associated with better weight control both in the short and long term (O'Neil and Brown, 2005), improving the chances of success (Wing et al., 2008) and may be an important element of a behavioural intervention (Michie et al., 2009). On the contrary, it has been suggested that self monitoring may promote *increases* in psychological distress and attrition (Dionne & Yeudall, 2005). Although it is difficult to determine from the information provided by the papers in the current review, it is possible that the effectiveness of some of the interventions reviewed may be due to such mechanisms. Further research, therefore, should focus on such psychological outcomes to elucidate the mechanisms by which behavioural interventions work. These outcomes should then be evaluated both in terms of participant needs and researchers outcomes, as these may not always be in tandem. In addition, researchers should strive to reduce potential bias in outcome reporting to improve the accuracy of results and effectiveness of intervention evaluation (Smyth et al. 2011). It is also important to note that the current findings pertain specifically to behavioural and/or dietary interventions with/without exercise. Different outcomes may be observed following other types of intervention, for example, surgical or pharmacological techniques and those studies which did not meet the inclusion criteria for the current review.

It is important to consider that particular methodologies adopted in intervention studies may also have a *positive* influence on participant behaviour. Participants may alter their behaviour, becoming 'healthier' as a direct result of participation (and being monitored). In such instances, a suitable control group or comparison group can detect such effects. However, the lack of suitable control groups or comparison groups in many of the studies reviewed supports the need for further research to test the possibility that simply taking part in a weight loss intervention can have psychological benefits (Brodie & Slade, 1990). Similar improvements in control conditions may support the suggestion that purely taking part in an intervention is beneficial. Generally, such effects are rare and the effects are not always of the same magnitude as that yielded by the intervention. Two of the studies included in this review did report improvements in psychological wellbeing in participants assigned to a control condition with medium effect sizes. These included improvements in self-esteem (Steinhardt et al., 1999) and body image (Teixeira et al., 2010). It could be argued that improvement in psychological outcome may be due to exercise. However, in the current review it is difficult to separate out the effect of exercise alone from other components of the intervention. Of the studies included, only three assessed the isolated impact of exercise. However, of these studies, two found exercise to be ineffective (Imayama et al., 2011; Messier et al., 2010) while Kiernan et al. (2001) observed improved psychological outcomes with exercise in males only.

The control conditions adopted in the studies reviewed differed in the treatment (or lack of) that participants received. Typically, a control condition means that the participant receives some form of standard care or comparative treatment to an intervention. Studies in the current review included general health advice, dietary advice or social skill development as a control or comparison. Here, there is scope for changes in eating and exercise and it is possible, therefore, that psychological benefits may accompany these changes. No consistent pattern seems to emerge as to those 'types' of control which yield positive results. Steinhardt et al. (1999) observed improvements in self-esteem in participants who did not receive any form of treatment (and yet still achieved a medium effect size). Conversely, Teixeira et al. (2010) provided control participants with general health advice (including stress management, self-care and effective communication) and found improvements in perceived body image. It is apparent from these observations that simply taking part in a study of this nature as part of a control condition or intervention can yield psychological benefits. However, despite the promising magnitude of these effects, there is currently minimal support for this.

The variety of changes observed following weight loss may be influenced by adequacy of study design. The quality of the studies included in this review varied but demonstrated a generally acceptable level of quality. However, one consistent methodological limitation was a lack of a suitable comparison group or control. Out of 36 studies included in the review, only 9 studies included a comparison group or control condition. Inclusion of an appropriate comparison (for example, standard care or caloric restriction or exercise compared to a behavioural intervention) would allow for a more comprehensive assessment of the success of the intervention in question. In a meta-analysis of HRQoL following weight loss interventions, Maciejewski et al. (2005) assessed the quality of 34 randomised controlled trials (RCTs) and suggested that poor quality design produced inconsistent results. Some RCT studies included in the review failed to include pre to post measures (with or without follow ups), used non-standardised measures, or failed to account for missing data (Maciejewski et al., 2005). Out of the 36 studies included in the current review, only five were RCTs. Furthermore, in many studies only a narrow range of psychological domains i.e. only self-esteem and/or depression were assessed. In most weight loss intervention studies, psychological outcomes are secondary to the potential change in weight (Maciejewski et al., 2005) and as such, studies may not be adequately powered to assess change in psychological outcome. This may also explain the observed variation in effect sizes across the studies included in this review for all outcome measures. The variety of measures used to assess the same psychological construct is also problematic. Measures may vary in sensitivity to the construct under investigation or may emphasise one or more of its elements. This often makes comparisons between studies difficult and is particularly pertinent for measures of body image. In the current review, body image was assessed by no less than eleven different measures in only fourteen studies in comparison to one for self-esteem and two for depression and HRQoL. Some measures may lack sensitivity to changes in mood and wellbeing or may be prone to an inflated sense of wellbeing due to demand characteristics. However, it must be noted that despite variation in the measures

adopted by the studies in the current review, change in body image did not differ by measure. Further, the consistent improvement in body image and medium to large effect sizes in spite of these variations in methodology lends support to a seemingly robust and reliable effect.

Accounting for missing data in intervention studies is often problematic with many studies utilising a per protocol analysis (PP). PP analyses are subject to bias given that the analysis is conducted only on those who completed the intervention. A preferred method, to avoid such bias, is the intention-to-treat (ITT) approach in which all data are analysed regardless of whether the participant dropped out of the study (Ware, 2003). More recently, researchers have suggested that techniques such as multiple imputation or maximum likelihood estimation further reduce bias and are significantly more reliable (Enders, 2010). Out of the 36 studies included in this review, only 7 studies adopted an ITT approach, with the majority either adopting a PP approach or failing to account for missing data in the report. Studies frequently commented on the number of dropouts and compared characteristics of completers and non-completers but proceeded to exclude non-completers from the analysis. This is clearly something which future studies need to consider when analysing intervention data. It is especially important given in some cases, dropouts were heavier individuals suffering greater psychological distress, lower self-esteem and poorer HRQoL (Hope et al., 2010; Lim et al., 2009; Paxman, Hall, Harden, O'Keeffe, & Simper, 2011).

The majority of the studies included in this review demonstrated improvements in psychological outcomes in the time frame of the intervention suggesting that participation in a weight loss intervention is beneficial. Some effects were maintained for more than one-year post completion. Improvements in measures of body image were maintained at 16-months (Palmeira et al., 2010) and 1 year (Nauta et al., 2001) post intervention. Other behavioural intervention studies have also shown improvements in body size dissatisfaction and body shape concerns concurrent with (and significantly correlated with) weight loss post 12-month intervention (Palmeira et al., 2009). Teixeira et al. (2006) also observed improvements in body image that were maintained at one-year post intervention. Similar changes in HRQoL (Blissmer et al., 2006), self-esteem and depression (Nauta et al., 2001; Steinhardt et al., 1999) have been observed. Behavioural and/or dietary interventions often educate participants in healthy diet and appropriate eating behaviours in addition to some element of cognitive restructuring to promote self-acceptance and health attitudes. It is possible that this training enables individuals to implement new longer-term behavioural strategies, which promote longer-term success (even in the absence of weight loss maintenance). However, not all the studies in this review included (or reported) follow-ups to assess psychological benefits in the long term. This would be the preferred design for future studies in this area.

Recommendations for future research

Consideration of the studies presented in the current review highlights the need for more research into the psychological outcomes of weight loss interventions of this nature. Although the quality of studies included was generally acceptable, the variation in methodology and frequent lack of suitable control or comparison groups suggests that further research addressing these design issues is required to fully elucidate the effect of participation in a weight loss trial on psychological outcomes with or without weight loss. Studies should be explicit in their rationale, selection and description of the sample under investigation with an adequate baseline psychological assessment using a standard set of measures assessing a broader range of psychological correlates prior to participation in the intervention both pre- and post intervention and with appropriate interim assessments. Further, adherence to the intervention should be explicitly monitored over the duration of participation with measures of compliance. Studies should include a suitable control group not receiving treatment or a suitable comparison group, which would permit more reliable inferences about the effects of the intervention. Importantly, studies need to directly assess the relationship between actual weight loss and degree of improvement in psychological outcomes and to employ a more sophisticated statistical analysis which minimises bias, for example, to identify not only correlates of weight loss but also mediators. The longevity of these effects should be assessed where possible together with an assessment of whether such effects are maintained with or without weight loss maintenance. The findings of the current review are limited to a sample of otherwise healthy male and female adults. The outcomes, therefore, may not extrapolate to other potentially vulnerable groups and so this should be explored. It would also be of value to see a more active exploration of gender differences in the study of psychological benefits of weight loss. Of the 36 studies included in the current review, approximately half of the studies were conducted in females only. Of those which included both males and females, more females than males took part, which led to unbalanced samples. Effects of gender on the outcomes measured were rarely formally assessed. Interestingly, one study reported changes in HRQoL to be gender specific in that males demonstrated improvement in the physical HRQoL domain whereas females demonstrated psychological and emotional improvements (Wu et al., 2009). It would be useful, therefore, for future studies to explore this in more detail. Finally, to enhance the effectiveness of the interventions used, it is of value to identify the key components that lead to success and, further, to develop a more comprehensive, inclusive definition of 'success' that includes both improved psychological outcomes together with physiological changes.

Conclusions

A review of 36 studies demonstrated consistent significant improvements in psychological outcomes following participation in a behavioural and/or dietary weight loss intervention both with and without exercise, post intervention and at one year follow up. Specifically, improvements in self-esteem, depressive symptoms, body image and health-related quality of life (HRQoL, especially vitality) were observed. Calculated effect sizes to determine the magnitude of change pre- to post- intervention demonstrated substantial variation across interventions and outcomes. Showing more consistency and larger changes in body image and vitality. However, it was not possible to calculate effect sizes for all pre- to post- comparisons of interest. Consequently, not all observed effects could be supported and should be treated with caution. Improvements generally increased in magnitude with greater weight loss but were also observed with no weight change. Greater weight loss was more strongly associated with greater improvements in HRQoL. The type of intervention may mediate this effect in that diet/exercise based interventions may be more dependent on weight loss for improved wellbeing whereas behavioural interventions with a psychological focus (whereby weight loss is not the primary or only goal), may enhance autonomy and serve to change attitudes and promote positive psychological wellbeing. Greater weight loss and/or self-acceptance may mean that these effects can be maintained over longer periods of time. Despite a generally acceptable standard of quality, quality assessment scores varied and a number of methodological issues were identified. More research, therefore, is needed to improve the quality of intervention trials to fully elucidate the effects of weight loss on psychological outcomes, to identify the effective elements of interventions used and to incorporate a broader range of psychological domains, for example, self-efficacy and autonomy.

Appendix A

Quality Assessment Tool

Quality Assessment Sheet: Psychological Benefits of Weight Loss

A. Overview of study	1, 2, 3, 4, 12, 13, 17, 18
B. Data collection	5, 6, 7, 8
C. Manipulation	9, 10, 11
D. Outcomes and analysis	14, 15, 16

Paper: **Rater:**

Score 0 if criterion not satisfied. Score 1 if criterion satisfied. **Score:**

#	Criterion	Score	Comments
1	Clear aims and objectives stated		
2	Clear description of setting/environment e.g. clinical/primary care, community, commercial		
3	Clear description of sample e.g. age (m, sd, range), gender, n		
4	Clear description of study design		
5	Clear description of data collection		
6	Provision of recruitment data and strategy		
7	Provision of attrition data		
8	Provision of compliance data i.e. adherence to intervention		
9	Clear description of intervention e.g. nutritional guidance, exercise, lifestyle guidance etc.		
10	Inclusion of a suitable control or comparison group.		
11	Evidence of assessment of prior health i.e. co-morbidities		
12	Sufficiency of sample selection, blinding, counterbalancing or placebo comparison n.b. within limitations of study design		
13	Sufficiency of assessment of psychological outcomes in conjunction with physiological changes e.g. appropriate, valid and reliable outcomes		
14	Clear description of data analysis		
15	Appropriateness of data analysis		
16	Clear description of findings		
17	Strengths of study and suggestions for future work		
18	Limitations of study		

General comments:

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